

Use of Spent Engine Oil

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Abstract

This paper reports on the analysis into suitability of the use of spent engine oil for other purposes. The composition and source of engine oil that bring about the spent oil was discussed; the functions of the engine oil were highlighted; the characteristics and properties of the oil were also discussed. In this work, how the spent engine oil can be refined to suit other purposes including the test that was carried out on the spent engine oil were also discussed. Three samples of oil; fresh engine oil, spent engine oil and refined spent engine oil were analyzed. The results obtained from the analysis, show that the refined spent engine oil with activated clay compared favourably with the fresh engine oil, except that, there is need for additive to upgrade the oil standard SAE values. The analysis shows that the spent engine oil has some certain degree of lubricating properties that are acceptable for other application.

Keywords: Analysis, refine, SAE, additives, activated clay, fresh engine oil, lubricating properties.

Introduction

In engineering the life of machinery is very important and oil can be said to play a vital role in conserving its working life and also is the blood of an engine and just like the blood in our own bodies, it does not only lubricates but carries away heat, dissolves contaminant, carries away debris and provide a working medium for many engines.

Engine oil could be stock or synthetic but all have additive packages mixed into it. The additives mixed with the base stock appreciably improve the service properties of engine oil as a result of their action; viscosity of the oil is raised, there is improvement in viscosity temperature, lowering the pour point, increment in stability of oil reducing the aggressive action of oil, improvement of lubricating ability of an engine oil, etc.

Spent engine oil is typically refers to as used motor oil that have been collected from oil changed workshops, garages, and industry sources such as hydraulics oil, turbine oils, process oil and metal working fluids. Spent oil can also originates at seaports from ocean going vessels which can contain salt sea water,

heavy and intermediate fuel oil along with various heavy metals common to such fuel oil.

Spent engine oil contains blow by gasoline and diesel fuel from the engine it lubricated. It can also contain rogue materials such as chlorinated solvent. Once the spent engine oil is generated there are equipments and procedures in which the used oil can be tested and this helps to know how the spent engine oil would assume different classification where they can be used again or the kind of handling safety that will be applied when blending it for other purposes.

Since it is liquid, spent engine oil will migrate into the environment and eventually finds its way to contaminate either water or soil. Spent engine oil can be properly analyzed to suit other purposes ranging from generation of electricity, uses in industrial burners, mixing with asphalts for paving space waters in automotives bays, etc, to mention but few.

Spent engine oil needs to be analyzed because of the component which has a very crucial importance in any processing plant and in the value added product composition. Challenge of processing spent engine oil into value product is very great. It is also

significantly different from processing of crude oil.

Spent engine oil analysis involves sampling and analyzing for various compositions properties of the oil in order to determine a suitable place where it can be used, for safety purposes in order not to cause safety and environmental threat.

Theoretical Analysis

Source and Composition of Engine Oil

The most important consideration in engine oil is the reduction of friction and control of wears; where viscosity is the primary factor performance which was obtained by blending base stock or base oil with various compositions of various additives. So achieving the right viscosity relies on selecting the right base stocks and blending item with performance additive to enhance functional performance. With the advancement in refinery technologies specifically in lube processing, a sophisticated refining technique, e.g., hydro treating / hydro cracking, have been introduced to convert the undesirable component of the base stocks. Basically, the base stock used in the formulation of engine oil is either of mineral (petroleum) or synthetic origin.

Mineral base oil is those products obtained from refining petroleum crude. While synthetic on the other hand is those products made from petroleum or vegetable feed stock and are often "tailor made" for specific application.

The additives blended with this base oil are of different range and these include the following: anti-wears and friction additives, extreme pressure agent antioxidants, corrosion and rust inhibitors, pour point depressants, anti-foam additive, metal deactivators, viscosity index improver.

Mechanism of Refining Spent Engine Oil

Refining of spent engine oil is the process of regenerating its used substance so that it can be used again. It is the process involving the removal of the impurities in the spent oil and bringing it back to the initial state.

The choice of method of regenerating base oil is determined by the nature of the spent oil, some requires purification from mechanical impurities while others require deep purification with the use of chemical and physical methods.

The physical method includes removal of dirt, sand-metal particles and combustible substance. This include; centrifugation, setting filtrations, distillation etc. Refining the spent engine oil will only bring back the base oil without additives (Labones 1990).

Adsorption Mechanism

The adsorption treatment of oil is based on the ability of adsorbent to selectively extract resinous and sulphur containing compounds, unsaturated and polycyclic material and also organic residues of sulphuric acid and solvents from oils.

Natural clay is used as adsorbent in the treatment of oils clay that has been activated and dried up. There are basically two treatment methods these are contact treatment and percolation or filtration through a bed of granulated adsorbent (Holdeidge 1966).

Contact Treatment

In this type of treatment the oil mixed with finely grounded clay uses adsorbent depends on the degree of its contaminant with the oil is heated to lower the viscosity of the oil and improves its penetration into adsorbent pores. The process temperature depends on the quality of the stock, the nature of adsorbent and the required degree of product purification.

Most often, light distilled oils are subjected to contacting at 80°–12°C. The efficiency of the process is affected by duration of contact of the oil with the clay. This time generally is 20 to 25 min (Grim 1962).

Percolation Method

In this method, filtration is performed through a layer of granulated adsorbent when the latter is stationary. The oil is filtrated through a fixed bed of clay with particles from 0.3 to 2mm in size. The filter is a vertical

hallow cylindrical apparatus packed with the adsorbent, which is the clay, the first portion of spent oil are purified. As the adsorbent becomes saturated with the substances extracted from the oil, the extent of purification drops. The entire filtrate is gathered in one tank (Grim 1962).

Factors for Rate of Adsorption

The factors that affect the rate at which substances is adsorbed by the adsorbent include:

- i. Time of contact of the substances to be adsorbed with the adsorbent;
- ii. Temperature of substance to be refined;
- iii. Concentrator;
- iv. Nature of the adsorbent (Gains and Thomas 1955).

Experimental Analysis

Clay Preparation

Brownish-red clay was used and apparatus used include jars, sieve conical flask, bowls, oven, distilled water.

Method:

- i. The clay sample was grounded and then make into slurry in distilled water.
- ii. Impurities such as sand and stone settled at the bottom. Then were get rid off by decanting.
- iii. The slurry was kept in an oven at temperature of 110°c to be dried up.
- iv. The dried clay was grounded into very fine particles and sieved to a mesh of 0.5 mm using test sieve on a mechanical shaker.

Clay Activation

Apparatus: Aluminum pan, plastic bowl, oven, burner clay, distilled water.

Method:

- i. 200g of clay (after dirt, sand and stone have been removed) was made into slurry with distilled water of about 80cm^3
- ii. $50\text{-}60\text{cm}^3$ of acid in 0.35 mole/cm^3 concentration was added to the slurry made

iii. The slurry into aluminum pan and left for one hour at temperature between $90\text{-}100^{\circ}\text{c}$

iv. After the time duration, the mixture was washed with distilled water in order to remove any excess acid. The pH of washing water was monitored until it was found to be neutral.

v. The washed clay mixture was dried in an oven for one hour and grounded into powdery form. (Oboh and Aworh 1991).

Purification Process of Spent Engine Oil

The spent engine oil was purified using activated clay. The activated clay was grounded and mixed with the spent engine oil that has been already heated for about 5 min, the mixture was stir together thoroughly with the aid of electric stirrer.

The mixture was kept till the following day so that there will be some chemical reaction between the spent oil and the activated clay. The impurities in the spent engine oil, had already settled the following day with the clay particles then the oil was sieve with the aid of cloth.

Functions of Engine Oil

The function of engine oil includes reduction of friction, protection against rust and corrosion, lubrication of engine parts, easy starting for engine and keeping of engine parts clear

Results and Discussion

The results are shown in Tables 1 – 3. Activity of the clay enhances the refining capacity of the clay and increased the adsorbing power. Since it was 0.3 activated clay that was used as the test clay, Table 3 gives the analysis of the clay day before and after activation.

Application of Spent Engine Oil

Once the spent engine oil has been collected and analysis based on its parameter earlier discussed in this work, it has assumed different classification as it can now be used for different purposes. This includes:

Table 1. Analysis showing sample of clay before and after activation.

Test analysis	Activated clay sample	Inactivated clay sample
% moisture content	88.66	90.02
% ash content	3.40	6.79
% Fe ₂ O ₃	43.87	48.22
% loss on ignition	5.31	3.04

Table 2. Result of analysis of samples of engine oils.

Test	Fresh engine oil	Spent engine oil	Refined spent engine oil
Kinematics viscosity at 40°C	22 - 248	111.132	200
Kinematics viscosity at 100°C	18.5 - 22	17.83	18
Viscosity index	95	99	96.8
Flash point	246	230	239
Pour point	-12	-10	-12
TBN (MgKOH)/g	4.8	-	-
% sulphated mass	1.2	4.5	2.9
Specific gravity	0.899	0.928	0.920

Table 3. Analysis of the clay before and after activation.

Test analysis	Activated clay	Inactivated clay
% Moisture content	88.66	90.02
pH Value	3.40	6.79
Ash content	43.87	48.22
% Fe ₂ O ₃	5.31	3.04
% Loss of ignition	66.13	51.78

i. Reprocessed to residual replacement fuel oil: The spent engine oil can be blended with high sulphur content of the fuel oil

consumed. This blended fuel oil is typically consumed in electrical power generation facilities. These electric utilities will gain air emission credit for this practice since they burn a fuel of relatively sulphur content than if they burned only the refined.

A significant end use of spent engine oil is large energy user such as cement and lime kilns and steel mills. Such equipment and processes operate at very elevated temperature and consume huge quantities of energy. The fuel utilized for such application is typically low grade and low value (Institute of Petroleum 1987).

ii. Thermal cracking the spent engine oil to produce distilled gas oil: Gas oil is a petroleum distillate that is also called heating oil, furnace oil, diesel fuel, stove oil, etc. It has a boiling range that generally starts at 200°C and ends about 36°C. This thermal cracking of spent engine oil process helps in breaking the large hydrocarbons molecules into smaller ones by application of sufficient heat in a pressurized vessel. In this fashion, large molecules of more viscosity and less valuable hydrocarbons are converted to less viscous and more valuable liquid fuels thus increasing its values (Institute of Petroleum 1987).

Conclusion

In conclusion, the activated clay sample used for refining the spent engine oil improved its properties. The physical method of refining the spent engine oil with the clay sample that was activated is a surface phenomenon depending on the specific affinity between the adsorbent and the adsorbate dispersed in the spent engine oil.

Though the treatment improved the color of the oil, its stability and viscosity index and carbon residue, there are still more disadvantages associated with the contact treatment of the spent engine oil with the activated clay. The shortcomings of these, include the regenerating the adsorbents and the loss of oil with the adsorbents decomposition.

More so, sometimes contact treatment does not yield oil at sufficiently high quality with respect to its color.

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